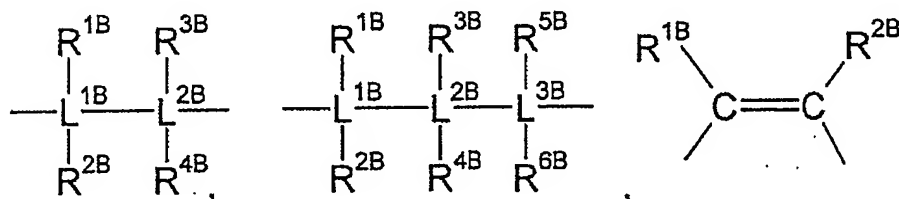


We claim:

1. A monocyclopentadienyl complex which contains the structural feature of the formula  $(\text{Cp})(-\text{Z}-\text{A})_m\text{M}$  (I), where the variables have the following meanings:

$\text{Cp}$  is a cyclopentadienyl system,

$\text{Z}$  is a bridge between  $\text{A}$  and  $\text{Cp}$  and is selected from the group consisting of



where

$\text{L}^{1\text{B}}-\text{L}^{3\text{B}}$  are each, independently of one another, carbon or silicon,

$\text{R}^{1\text{B}}-\text{R}^{6\text{B}}$  are each, independently of one another, hydrogen,  $\text{C}_1$ - $\text{C}_{20}$ -alkyl,  $\text{C}_2$ - $\text{C}_{20}$ -alkenyl,  $\text{C}_6$ - $\text{C}_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part or  $\text{SiR}^{7\text{B}}_3$ , where the organic radicals  $\text{R}^{1\text{B}}-\text{R}^{6\text{B}}$  may also be substituted by halogens and two geminal or vicinal radicals  $\text{R}^{1\text{B}}-\text{R}^{6\text{B}}$  or a radical  $\text{R}^{1\text{B}}-\text{R}^{6\text{B}}$  and  $\text{A}$  may also be joined to form a five- or six-membered ring and

$\text{R}^{7\text{B}}$  are each, independently of one another, hydrogen,  $\text{C}_1$ - $\text{C}_{20}$ -alkyl,  $\text{C}_2$ - $\text{C}_{20}$ -alkenyl,  $\text{C}_6$ - $\text{C}_{20}$ -aryl or alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two radicals  $\text{R}^{7\text{B}}$  may also be joined to form a five- or six-membered ring,

$\text{A}$  is an unsubstituted, substituted or fused, heteroaromatic ring system,

$\text{M}$  is a metal selected from the group consisting of titanium in the oxidation state 3, vanadium, chromium, molybdenum and tungsten and

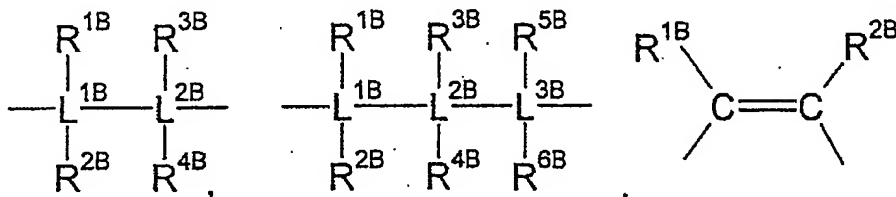
$m$  is 1, 2 or 3.

2. A monocyclopentadienyl complex as claimed in claim 1 of the formula  $(\text{Cp})(-\text{Z}-\text{A})_m\text{MX}_k$  (V), where the variables have the following meanings:

Cp is a cyclopentadienyl system,

Z is a bridge between A and Cp and is selected from the group consisting of

5



where

$L^{1B}-L^{3B}$  are each, independently of one another, carbon or silicon,

- 10  $R^{1B}-R^{6B}$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part or  $SiR^{7B}_3$ , where the organic radicals  $R^{1B}-R^{6B}$  may also be substituted by halogens and two geminal or vicinal radicals  $R^{1B}-R^{6B}$  may also be joined to form a five- or six-membered ring and

15

$R^{7B}$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl or alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two radicals  $R^{7B}$  may also be joined to form a five- or six-membered ring,

20

A is an unsubstituted, substituted or fused, heteroaromatic ring system,

M is a metal selected from the group consisting of titanium in the oxidation state 3, chromium, molybdenum and tungsten,

25

m is 1, 2 or 3,

X are each, independently of one another, fluorine, chlorine, bromine, iodine, hydrogen,  $C_1-C_{10}$ -alkyl,  $C_2-C_{10}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having 1-10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part,  $NR^1R^2$ ,  $OR^1$ ,  $SR^1$ ,  $SO_3R^1$ ,  $OC(O)R^1$ , CN, SCN,  $\beta$ -diketonate, CO,  $BF_4^-$ ,  $PF_6^-$  or a bulky noncoordinating anion,

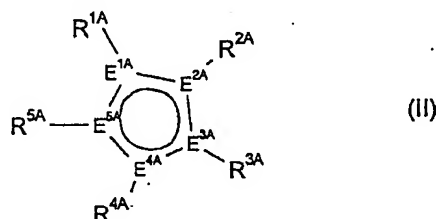
30

$R^1-R^2$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -ary, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part,  $SiR^3_3$ , where the organic radicals  $R^1-R^2$  may also be substituted by halogens and two radicals  $R^1-R^2$  may also be joined to form a five- or six-membered ring,

$R^3$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two radicals  $R^3$  may also be joined to form a five- or six-membered ring and

$k$  is 1, 2 or 3.

3. A monocyclopentadienyl complex as claimed in claim 1 or 2, wherein the cyclopentadienyl system Cp has the formula (II):



where the variables have the following meanings:

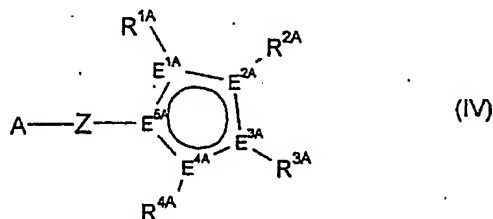
$E^{1A}-E^{5A}$  are each carbon or not more than one  $E^{1A}$  to  $E^{5A}$  is phosphorus,

$R^{1A}-R^{5A}$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part,  $NR^{6A}_2$ ,  $N(SiR^{6A}_3)_2$ ,  $OR^{6A}$ ,  $OSiR^{6A}_3$ ,  $SiR^{6A}_3$ ,  $BR^{6A}_2$ , where the organic radicals  $R^{1A}-R^{5A}$  may also be substituted by halogens and two vicinal radicals  $R^{1A}-R^{5A}$  may also be joined to form a five- or six-membered ring, and/or two vicinal radicals  $R^{1A}-R^{5A}$  are joined to form a heterocycle which contains at least one atom from the group consisting of N, P, O and S, and where 1, 2 or 3 substituents  $R^{1A}-R^{5A}$  is a group -Z-A and

$R^{6A}$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl radical and 6-20 carbon atoms in the aryl radical and two geminal radicals  $R^{6A}$  may also be joined to form a five- or six-membered

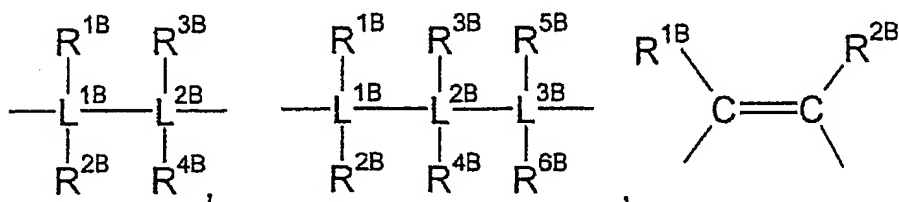
ring.

4. A monocyclopentadienyl complex as claimed in any of claims 1 to 3, wherein the cyclopentadienyl system Cp together with -Z-A has the formula (IV):



where the variables have the following meanings:

- 10  $E^{1A}-E^{5A}$  are each carbon or at most one  $E^{1A}$  to  $E^{5A}$  is phosphorus,
- $R^{1A}-R^{4A}$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part,  $NR^{6A}$ ,  $N(SiR^{6A})_2$ ,  $OR^{6A}$ ,  $OSiR^{6A}_3$ ,  $SiR^{6A}_3$ , where the organic radicals  $R^{1A}-R^{4A}$  may also be substituted by halogens and two vicinal radicals  $R^{1A}-R^{4A}$  may also be joined to form a five- or six-membered ring, and/or two vicinal radicals  $R^{1A}-R^{4A}$  may be joined to form a heterocycle containing at least one atom from the group consisting of N, P, O and S,
- 20  $R^{6A}$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two geminal radicals  $R^{6A}$  may also be joined to form a five- or six-membered ring.
- 25 A is an unsubstituted, substituted or fused, heteroaromatic ring system,
- Z is a bridge between A and Cp and is selected from the group consisting of



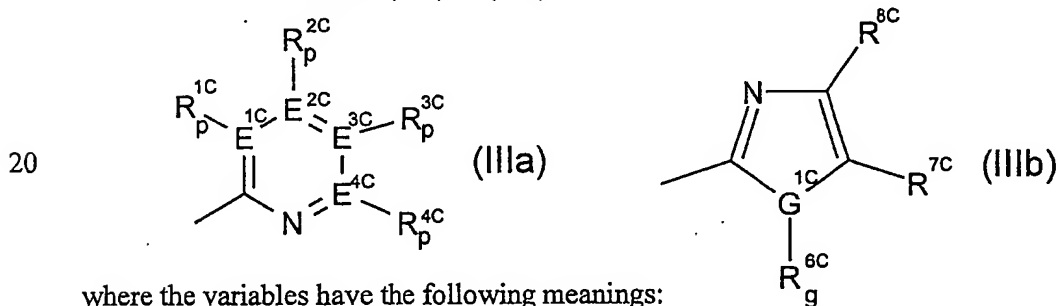
30 where

$L^{1B}-L^{3B}$  are each, independently of one another, carbon or silicon,

$R^{1B}-R^{6B}$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part or  $SiR^{7B}_3$ , where the organic radicals  $R^{1B}-R^{6B}$  may also be substituted by halogens and two geminal or vicinal radicals  $R^{1B}-R^{6B}$  may also be joined to form a five- or six-membered ring and

$R^{7B}$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl or alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two radicals  $R^{7B}$  may also be joined to form a five- or six-membered ring.

5. A monocyclopentadienyl complex as claimed in any of claims 1 to 4, wherein A has the formula (IIIa) or (IIIb):



$E^{1C}-E^{4C}$  are each carbon or nitrogen,

$R^{1C}-R^{4C}$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part or  $SiR^{5C}_3$ , where the organic radicals  $R^{1C}-R^{4C}$  may also be substituted by halogens or nitrogen and further  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part or  $SiR^{5C}_3$  groups and two vicinal radicals  $R^{1C}-R^{4C}$  or  $R^{1C}$  and Z may also be joined to form a five- or six-membered ring and

$R^{5C}$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl or alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two radicals

$R^{5C}$  may also be joined to form a five- or six-membered ring and

p is 0 when  $E^{1C}-E^{4C}$  is nitrogen and 1 when  $E^{1C}-E^{4C}$  is carbon,

5  $G^{1C}$  is nitrogen, phosphorus, sulfur or oxygen,

$R^{6C}-R^{8C}$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part or  $SiR^{9C}_3$ , where  
 10 the organic radicals  $R^{6C}-R^{8C}$  may also be substituted by halogens or nitrogen and further  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part or  $SiR^{9C}_3$  groups and two vicinal radicals  $R^{6C}-R^{8C}$  or  $R^{6C}$  and Z may also be joined to form a 5- or 6-membered ring and

15  $R^{9C}$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl or alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two radicals  $R^{9C}$  may also be joined to form a five- or six-membered ring and

20 g is 0 when  $G^{1C}$  is sulfur or oxygen and 1 when  $G^{1C}$  is nitrogen or phosphorus.

25 6. A monocyclopentadienyl complex as claimed in any of claims 1 to 5, wherein Z is selected from the group consisting of  $-C(R^{1B}R^{2B})-Si(R^{3B}R^{4B})-$ ,  $-CH_2-C(R^{3B}R^{4B})-$  and 1,2-phenylene.

7. A catalyst system for olefin polymerization comprising

30 A) at least one monocyclopentadienyl complex as claimed in claims 1 to 6,

B) optionally, an organic or inorganic support,

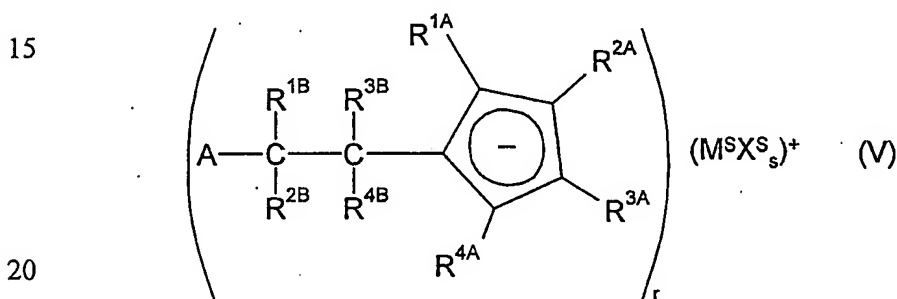
C) optionally, one or more activating compounds,

35 D) optionally, further catalysts suitable for olefin polymerization and

E) optionally, one or more metal compounds containing a metal of group 1, 2 or

13 of the Periodic Table.

8. A prepolymerized catalyst system comprising a catalyst system as claimed in claim 7 and one or more linear C<sub>2</sub>-C<sub>10</sub>-1-alkenes polymerized onto it in a mass ratio of from 1:0.1 to 1:1 000 based on the catalyst system.
9. The use of a catalyst system as claimed in claim 7 or 8 for the polymerization or copolymerization of olefins.
10. A process for preparing polyolefins by polymerization or copolymerization of olefins in the presence of a catalyst system as claimed in claim 7 or 8.
11. A process for preparing cyclopentadienyl systems of the formula (V):



where the variables have the following meanings:

R<sup>1A</sup>-R<sup>4A</sup> are each, independently of one another, hydrogen, C<sub>1</sub>-C<sub>20</sub>-alkyl, C<sub>2</sub>-C<sub>20</sub>-alkenyl, C<sub>6</sub>-C<sub>20</sub>-aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part, NR<sup>6A</sup><sub>2</sub>, N(SiR<sup>6A</sup><sub>3</sub>)<sub>2</sub>, OR<sup>6A</sup>, OSiR<sup>6A</sup><sub>3</sub>, SiR<sup>6A</sup><sub>3</sub>, where the organic radicals R<sup>1A</sup>-R<sup>4A</sup> may also be substituted by halogens and two vicinal radicals R<sup>1A</sup>-R<sup>4A</sup> may also be joined to form a five- or six-membered ring, and/or two vicinal radicals R<sup>1A</sup>-R<sup>4A</sup> are joined to form a heterocycle which contains at least one atom from the group consisting of N, P, O and S.

R<sup>6A</sup> are each, independently of one another, hydrogen, C<sub>1</sub>-C<sub>20</sub>-alkyl, C<sub>2</sub>-C<sub>20</sub>-alkenyl, C<sub>6</sub>-C<sub>20</sub>-aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two geminal radicals R<sup>6A</sup> may also be joined to form a five- or six-membered ring,

A is an unsubstituted, substituted or fused, heteroaromatic ring system,

5  $R^{1B}-R^{4B}$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part or  $SiR^{7B}_3$ , where the organic radicals  $R^{1B}-R^{4B}$  may also be substituted by halogens and two geminal vicinal radicals  $R^{1B}-R^{4B}$  may also be joined to form a five- or six-membered ring and

10  $R^{7B}$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl or alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two radicals  $R^{7B}$  may also be joined to form a five- or six-membered ring,

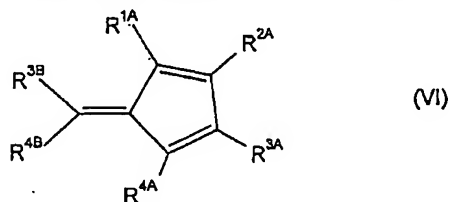
15  $M^S$  a metal of group 1, 2 or 3 of the Periodic Table of the Elements,

20  $X^S$  are each, independently of one another, fluorine, chlorine, bromine, iodine, hydrogen,  $C_1-C_{10}$ -alkyl,  $C_2-C_{10}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having 1-10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part,  $NR^1R^2$ ,  $OR^1$ ,  $SR^1$ ,  $SO_3R^1$ ,  $OC(O)R^1$ , CN, SCN,  $\beta$ -diketonate, CO,  $BF_4^-$ ,  $PF_6^-$  or a bulky noncoordinating anion and

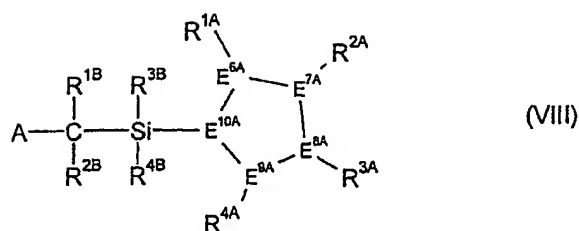
s 0, 1 or 2,

25 r 1 or 2, with the proviso that  $s + r$  is the oxidation state of  $M^S - 1$ ,

which comprises reacting  $(A-CR^{1B}R^{2B})_r(M^SX^S)^+$  with a fulvene of the formula (VI)



30 12. A process for preparing cyclopentadienyl systems of the formula (VIII):



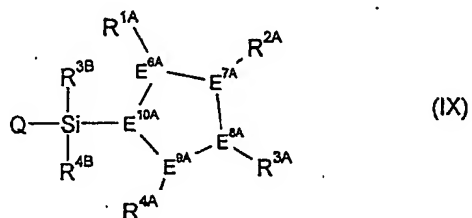
where the variables have the following meanings:

- 5     $E^{6A}-E^{10A}$     are each carbon or not more than one  $E^{6A}$  to  $E^{10A}$  is phosphorus, where four adjacent  $E^{6A}-E^{10A}$  form a conjugated diene system and the remaining  $E^{6A}-E^{10A}$  additionally bears a hydrogen atom,
- 10     $R^{1A}-R^{4A}$     are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part,  $NR^{6A}_2$ ,  $N(SiR^{6A}_3)_2$ ,  $OR^{6A}$ ,  $OSiR^{6A}_3$ ,  $SiR^{6A}_3$ , where the organic radicals  $R^{1A}-R^{4A}$  may also be substituted by halogens and two vicinal radicals  $R^{1A}-R^{4A}$  may also be joined to form a five- or six-membered ring, and/or two vicinal radicals  $R^{1A}-R^{4A}$  are joined to form a heterocycle which contains at least one atom from the group consisting of N, P, O and S,
- 15     $R^{6A}$     are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two geminal radicals  $R^{6A}$  may also be joined to form a five- or six-membered ring,
- 20    A    is an unsubstituted, substituted or fused, heteroaromatic ring system,
- 25     $R^{1B}-R^{4B}$     are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part or  $SiR^{7B}_3$ , where the organic radicals  $R^{1B}-R^{4B}$  may also be substituted by halogens and two geminal or vicinal radicals  $R^{1B}-R^{4B}$  may also be joined to form a five- or six-membered ring, and
- 30     $R^{7B}$     are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl or alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two radicals

$R^{7B}$  may also be joined to form a five- or six-membered ring,

which comprises reacting  $(A-CR^{1B}R^{2B-})_r(M^S X^S_s)^+$  with a cyclopentadienyl system of the formula (IX)

5



where the variables are as defined above and

10    Q        is a leaving group.